

$$1 \quad \begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \alpha \begin{pmatrix} I_m \\ Q_m \\ U_m \\ V_m \end{pmatrix} + (1 - \alpha) \begin{pmatrix} I_{nm} \\ Q_{nm} \\ U_{nm} \\ V_{nm} \end{pmatrix}$$

$Q_{nm} = U_{nm} = V_{nm} = 0$ (luz no polarizada \implies los componentes E_1 y E_2 incoherentes $\equiv \langle E_1 E_1^* \rangle = \langle E_2 E_2^* \rangle$ y $\langle E_1 E_2^* \rangle = \langle E_2 E_1^* \rangle = 0$; luego mirar las definiciones de los parámetros Stokes)

$$\implies \begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \begin{pmatrix} \alpha I_m + (1 - \alpha) I_{nm} \\ \alpha Q_m \\ \alpha U_m \\ \alpha V_m \end{pmatrix}$$

Para la parte magnética en el campo débil: (del pdf escaneado)

$$V_m = -\Delta \lambda_B \cos \theta \frac{dI_m}{d\lambda}$$

$$\text{Suponemos } I_m = I_{nm} \implies I = I_m$$

$$V = \alpha V_m$$

$$\implies V = -\alpha \Delta \lambda_B \cos \theta \frac{dI}{d\lambda}$$

2 Notacion para la configuración de los electrones de un átomo:

$$^{2S+1}L_J$$

pero en lugar del valor de L se usan letras:

$$S \equiv L = 0$$

$$P \equiv L = 1$$

$$D \equiv L = 2$$

$$F \equiv L = 3$$

donde los números cuanticos: S representa el spin, L el momento angular orbital y J el momento angular total (spin y momento angular orbital) considerando todos los electrones del átomo

el valor del factor Landé para cada nivel de la transición:

$$g = 1 + \frac{J(J+1) + S(S+1) - L(L+1)}{2J(J+1)} \text{ si } J \neq 0 \text{ y } g = 0 \text{ si } J = 0$$

el valor del factor Landé efectivo de la transición:

$$\bar{g} = \frac{1}{2}(g_1 + g_2) + \frac{1}{4}(g_1 - g_2)(J_1(J_1 + 1) - J_2(J_2 + 1))$$

donde los valores $_1$ son del nivel antes de la transición y los valores $_2$ después

1. $5D_2 - 7D_3$ (Fe I, $\lambda = 5247.1$ Å)

$$5D_2 \implies S_1 = 2, L_1 = 2, J_1 = 2 \implies g_1 = 1 + \frac{6+6-6}{12} = \frac{3}{2}$$

$$7D_3 \implies S_2 = 3, L_2 = 2, J_2 = 3 \implies g_2 = 1 + \frac{12+12-6}{24} = \frac{7}{4}$$

$$\bar{g} = 2$$

2. $5D_0 - 7D_1$ (Fe I, $\lambda = 5250.2$ Å)

$$5D_0 \implies S_1 = 2, L_1 = 2, J_1 = 0 \implies g_1 = 0$$

$$7D_1 \implies S_2 = 3, L_2 = 2, J_2 = 1 \implies g_2 = 1 + \frac{2+12-6}{4} = 3$$

$$\bar{g} = 3$$

3. $5F_1 - 5D_0$ (Fe I, $\lambda = 5576.1$ Å)

$$5F_1 \implies S_1 = 2, L_1 = 3, J_1 = 1 \implies g_1 = 1 + \frac{2+6-12}{4} = 0$$

$$5D_0 \implies S_2 = 2, L_2 = 2, J_2 = 0 \implies g_2 = 0$$

$$\bar{g} = 0 \text{ (magnetic insensitive line)}$$

4. $5P_2 - 5D_2$ (Fe I, $\lambda = 6301.5$ Å)

$$5P_2 \implies S_1 = 2, L_1 = 1, J_1 = 2 \implies g_1 = \frac{11}{6}$$

$$5D_2 \implies S_2 = 2, L_2 = 2, J_2 = 2 \implies g_2 = \frac{3}{2}$$

$$\bar{g} = \frac{5}{3}$$

5. $5P_1 - 5D_0$ (Fe I, $\lambda = 6302.5$ Å)

$$5P_1 \implies S_1 = 2, L_1 = 1, J_1 = 1 \implies g_1 = \frac{5}{2}$$

$$5D_0 \implies S_2 = 2, L_2 = 2, J_2 = 0 \implies g_2 = 0$$

$$\bar{g} = \frac{5}{2}$$

3 $\Delta\lambda_B = k\lambda_0^2 g B$

donde $k = 4.67 \cdot 10^{-13} \text{Å}^{-1} \text{G}^{-1} = 4.67 \cdot 10^{-3} \text{m}^{-1} \text{G}^{-1}$

y g es el factor Landé efectivo de la transición (\bar{g})

$$\Delta\lambda_D = \Delta\lambda_B \iff B = \frac{v}{ck\lambda_0 g}$$

donde v es la velocidad total (con los componentes de la velocidad térmica y microturbulencia) que aparece en la fórmula del ensanchamiento Doppler

Line: Halpha , Lambda: 6562.8 Å, $g = 1.0$

T = 15000.0 K, $v = 1.1212\text{e}+04$ m/s, d1D = 0.2453 Å

B = 200.0 G, d1B = 0.0040 Å

B = 1000.0 G, d1B = 0.0201 Å

B = 3000.0 G, d1B = 0.0603 Å

d1D = d1B \iff B = 12194.6568 G

Line: FeI , Lambda: 6302.5 Å, $g = 2.5$

T = 5000.0 K, $v = 1.3200\text{e}+03$ m/s, d1D = 0.0277 Å

B = 200.0 G, d1B = 0.0093 Å

B = 1000.0 G, d1B = 0.0464 Å

B = 3000.0 G, d1B = 0.1391 Å

d1D = d1B \iff B = 597.9685 G

Line: FeI , Lambda: 15648.0 Å, $g = 3.0$

T = 6000.0 K, $v = 1.3751\text{e}+03$ m/s, d1D = 0.0717 Å

B = 200.0 G, d1B = 0.0686 Å

B = 1000.0 G, d1B = 0.3430 Å

B = 3000.0 G, d1B = 1.0291 Å

d1D = d1B \iff B = 209.0781 G

4 $\Delta\lambda_B = k\lambda_0^2 g B$

$$\Delta\lambda_D = \lambda_0 \frac{v}{c}$$

$$S_m = \frac{\Delta\lambda_B}{\Delta\lambda_D} = C\lambda_0 g$$

donde $C = \frac{kBc}{v}$ no depende de λ_0 o g

$$\implies S_m \propto \lambda_0 g$$

<https://github.com/beevageeva/fsol/>